

N.B. 1) All questions are compulsory.

2) Figures to the right indicate full marks.

3) Use of logarithmic table/non programmable calculator is allowed.

Q.1 A) Attempt any two of the following:

a) In what way does Fourier transform spectroscopy differ from conventional spectroscopy? Discuss the advantages of the use of Fourier transform instruments. 4

b) With the help of block diagram, describe the dual wavelength spectrophotometer. What types of samples can be analysed by it? 4

c) Enlist different types of infrared transducers. Describe pyroelectric transducer. 4

d) What are the multichannel transducers? Discuss Photodiode array in detail. 4

B) Attempt any one of the following:

a) 'Methane exhibits λ_{\max} at 125nm while ethane exhibits λ_{\max} at 135nm.' Explain 4

b) A solution containing two absorbing species A and B was analyzed spectrophotometrically at two wavelengths in a 1.0cm cell. The absorbance of mixture was 0.799 and 0.165 at 530nm and 790 nm respectively. Calculate the molar concentration of two species A and B. If the molar absorptivity of the two species at two wavelengths is as follows. 4

Species	ϵ Molar absorptivity, $\text{mol}^{-1} \text{dm}^3 \text{cm}^{-1}$	
	530nm	790nm
A	8879	560
B	8879	8755

Q.2 A) Attempt any two of the following:

(a) Name different methods developed to compensate matrix effects in X-ray fluorescence analysis. Describe any one in detail. 4

(b) Explain the use of mass spectrometer as detector in hyphenated techniques. 4

(c) With the help of suitable diagram, explain energy dispersive instrument used in X-ray fluorescence. 4

(d) Name ion sources used in molecular mass spectrometry. Describe any one in detail. 4

B) Attempt any one of the following:

(a) Explain the term 'absorption edge' as applied to X-ray absorption spectra. Why is the wavelength of X-ray fluorescence greater than the absorption edge? 4

(b) Describe construction and working of Quadrupole mass analyzer. 4

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- Q. 3 A. Attempt any two of the following
- a) What are ion selective electrodes? Give the characteristic properties of membrane used in these electrodes. 4
 - b) Give an account of 'Ion selective field effect transistors'. 4
 - c) What are coulometric titrations? How they differ from volumetric titrations? 4
 - d) What is electrogravimetry? Explain the factors affecting the nature of deposit in electrogravimetry. 4

B. Attempt any one of the following:

- a) $\text{Ag}_{(s)} | \text{AgCl}_{(s)}, \text{Cl}^-(0.15\text{M}), \text{M}^{+2}(0.002\text{M}) | \text{M}_{(s)}$

The above cell is used for determination of M^{+2} ions by both electrogravimetry and coulometry. Calculate the potential that

(i) must be applied to prevent a current from developing in the cell when two electrodes are connected.

(ii) must be applied to cause an electrolytic current of 2.0 mA to develop. Assume that the internal resistance of the cell is 12.0 Ω .

Given : $E^0_{\text{Ag-AgCl/Cl}^-} = 0.222\text{V}$

$$E^0_{\text{Cd/Cd}^{+2}} = -0.403\text{V} \text{ and } \frac{2.303RT}{F} = 0.0592 \text{ at } 298\text{K}$$

- b) Calculate the time required for a constant current of 1.85 A to deposit 0.485g of
- (i) elemental Cobalt on a surface of cathode. 4
 - (ii) Co_3O_4 on an anode.
- Assume 100% current efficiency for both cases.
(At wt of Co = 58.9 O = 16, 1 Faraday = 96,500 C)

- Q.4 A) Attempt any two of the following:
- a) Derive Ilkovic equation starting with Cottrell equation 4
 - b) Give an account of differential pulse polarography. 4
 - c) Define: Half wave potential. Explain the effect of complex formation on half wave potential of a metal ion 4
 - d) What is stripping analysis? What is the purpose of electrodeposition in stripping analysis? Why are stripping methods more sensitive than other voltammetric methods? 4
- B) Attempt any one of the following:
- a) Discuss the inorganic applications of polarographic methods. 4
 - b) Calculate the concentration of Cd^{+2} ions in a solution which gave a diffusion current of 74 μA . 4

Given: Diffusion coefficient for $\text{Cd}^{+2} = 7.6 \times 10^{-5} \text{cm}^2 \text{s}^{-1}$, Rate of flow of mercury drops = 4.0 mg s^{-1} , drop time = 3.0 s

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Q.5 Attempt any four of the following:

- a) Explain the effect of solvents on λ_{\max} values in UV-visible spectroscopy.
- b) Describe the following terms with respect to IR spectroscopy
 - (i) Pelleting
 - (ii) Mulls
- c) Compare energy dispersive and wavelength dispersive X-ray fluorescence analysis.
- d) Explain the basic principle of mass spectrometry.
- e) Describe liquid membrane electrode used for determination of divalent metal ions.
- f) Differentiate between amperostatic coulometry and potentiostatic coulometry.
- g) Distinguish between voltametry and polarography
- h) Explain the effect of pH in organic polarography.

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